

APPENDIX

Changes to Title:

The following is a marked-up version of the amended title:

SYSTEM AND METHODS FOR DRIVING AN ELECTROOPTIC DEVICE ~~DRIVING
METHOD AND DRIVE CIRCUIT,
ELECTROOPTIC DEVICE, AND ELECTRONIC EQUIPMENT~~

Changes to Abstract:

The following is a marked-up version of the amended Abstract:

ABSTRACT OF THE DISCLOSURE

The invention provides a system and methods for driving an electrooptic device where
One-one field is divided into a plurality of subfields on a time base, thereby to set the
subfields as control units for driving a pixel. A liquid crystal that exhibits such a low
response rate that the saturation response time thereof is longer than one subfield period.
Accordingly, even when an ON voltage is applied to the liquid crystal in only one
predetermined subfield by way of example, the transmission factor of the liquid crystal does
not reach 100 %. That is, the change of the transmission factor in each subfield can be finely
controlled in the transitional period of the transmission factor of the liquid crystal.
ThusAccordingly, the number of gradations can be remarkably enlarged as compared with
the number of the subfields within one field, and displays at multiple gradations can be
realizedaccomplished.

Changes to Claims:

The following are marked-up versions of the amended claims:

1. (Amended) A drive circuit of an electrooptic device that supplies a display portion wherein pixels are constructed in a matrix shape out of an electrooptic material whose having a transmission factor for light that is variable by application of a voltage, with an ON voltage capable of saturating the transmission factor or an OFF voltage capable of bringing

the electrooptic material into a non-transmissive state, thereby to implement a subfield drive in which a gradation is expressed in accordance with states of a light transmissive state and the non-transmissive state of the electrooptic material in a unit time, and a time ratio of the states, the drive circuit comprising:

a drive means for setting~~device that sets~~ as control units a plurality of subfields into which a field period is divided on a time base, ~~for setting~~sets a time period of each of the subfields to be shorter than a saturation response time which is required for saturating the transmission factor of the electrooptic material in the case of applying the ON voltage, and ~~for determining~~determines, on the basis of display data, the subfields for which to apply the ON voltage ~~therein~~ and the subfields for which to apply the OFF voltage ~~therein~~, thereby to express the gradation.

2. (Amended) A drive circuit of an electrooptic device according to Claim 1, ~~wherein that~~ the saturation response time of the electrooptic material is being shorter than a field period of the display data.

3. (Amended) A drive circuit of an electrooptic device that supplies a display portion wherein pixels are constructed in a matrix shape out of an electrooptic material whose having a transmission factor for light that is variable by application of a voltage, with an ON voltage capable of saturating the transmission factor or an OFF voltage capable of bringing the electrooptic material into a non-transmissive state, thereby to implement a subfield drive in which a gradation is expressed in accordance with states of a light transmissive state and the non-transmissive state of the electrooptic material in a unit time, and a time ratio of the states, the drive circuit comprising:

a drive means for setting~~device that sets~~ as control units a plurality of subfields into which a field period is divided on a time base, ~~for setting~~sets a time period of each of the subfields to be shorter than a non-transmission response time which is required

SEARCHED
INDEXED
MAILED

for shifting the transmission factor of the electrooptic material from a saturated state into the non-transmissive state in the case of applying the OFF voltage, and ~~for determining that~~
~~determines~~, on the basis of display data, the subfields for which to apply the ON voltage ~~therein~~ and the subfields for which to apply the OFF voltage ~~therein~~, thereby to express the gradation.

4. (Amended) A drive circuit of an electrooptic device according to Claim 3, ~~wherein that~~ the non-transmission response time of the electrooptic material ~~is being~~ shorter than a field period of the display data.

5. (Amended) A drive circuit of an electrooptic device according to Claim 1-~~or~~ 3, ~~characterized in that said the drive means applies device applying the ON voltage to the electrooptic material in successive or non-successive subfields so that an integral value of the a transmissive state of the electrooptic material in the a pertinent field period may correspond corresponds to the display data.~~

6. (Amended) A drive circuit of an electrooptic device according to Claim 1-~~or~~ 3, ~~wherein that~~ the plurality of subfields within each field ~~are being~~ set at substantially the same time width.

7. (Amended) A drive circuit of an electrooptic device according to Claim 1-~~or~~ 3, ~~wherein that~~ the saturation response time ~~is being~~ a time period which is not shorter than three subfield periods.

8. (Amended) A drive circuit of an electrooptic device according to Claim 1-~~or~~ 3, ~~wherein that~~ the non-transmission response time ~~is being~~ a time period which is not shorter than three subfield periods.

9. (Amended) A drive circuit of an electrooptic device according to Claim 1, ~~wherein that~~ the ON voltage ~~is being~~ applied to the electrooptic material in a concentrated fashion in subfield periods on ~~the a~~ lead side of the field period.

10. (Amended) A drive circuit of an electrooptic device according to Claim 3, ~~wherein that the OFF voltage is being applied to the electrooptic material in a concentrated fashion in subfield periods on the a end side of the field period.~~

11. (Amended) A drive method of an electrooptic device that supplies a display portion wherein pixels are constructed in a matrix shape out of an electrooptic material ~~whose having a transmission factor for light that is variable by application of a voltage, with an ON voltage of, at least, a saturation voltage capable of saturating the transmission factor or an OFF voltage capable of bringing the electrooptic material into a non-transmissive state, thereby to implement a subfield drive in which a gradation is expressed in accordance with states of a light transmissive state and the non-transmissive state of the electrooptic material in a unit time, and a time ratio of the states, the method comprising:~~

~~_____ setting as control units a plurality of subfields into which a field period is divided on a time base,;~~

~~_____ setting a time period of each of the subfields to be shorter than a saturation response time which is required for saturating the transmission factor of the electrooptic material in the case of applying the ON voltage,; and~~

~~_____ determining on the basis of display data the subfields for which to apply the ON voltage therein and the subfields for which to apply the OFF voltage therein, thereby to express the gradation.~~

12. (Amended) A drive method of an electrooptic device that supplies a display portion wherein pixels are constructed in a matrix shape out of an electrooptic material ~~whose having a transmission factor for light that is variable by application of a voltage, with an ON voltage of, at least, a saturation voltage capable of saturating the transmission factor or an OFF voltage capable of bringing the electrooptic material into a non-transmissive state, thereby to implement a subfield drive in which a gradation is expressed in accordance with~~

states of a light transmissive state and the non-transmissive state of the electrooptic material in a unit time, and a time ratio of the states, the method comprising:

setting as control units a plurality of subfields into which a field period is divided on a time base,;

setting a time period of each of the subfields to be shorter than a non-transmission response time which is required for shifting the transmission factor of the electrooptic material from a saturated state into the non-transmissive state in the case of applying the OFF voltage,; and

determining on the basis of display data the subfields for which to apply the ON voltage therein and the subfields for which to apply the OFF voltage therein, thereby to express the gradation.

13. (Amended) A drive method of an electrooptic device according to Claim 11- or 12, wherein that the gradation is being expressed by applying the ON voltage to the electrooptic material in successive or non-successive subfields so that an integral value of the transmissive state of the electrooptic material in the pertinent field period may correspond to the display data.

14. (Amended) A drive method of an electrooptic device that divides each field into a plurality of subfields on a time base, and controls and drives a plurality of pixels which include an electrooptic material enclosed in intersection areas between a plurality of data lines and a plurality of scanning lines, by an ON voltage or an OFF voltage every subfield in accordance with display data, whereby the respective pixels display gradations within one field, the method comprising:

setting a time period of each of the subfields to be shorter than a saturation response time which is required for saturating the transmission factor of the electrooptic material in the case of applying the ON voltage,; and

_____ determining, on the basis of the display data, the subfields for which to apply the ON voltage therein and the subfields for which to apply the OFF voltage therein.

15. (Amended) An electrooptic device comprising the drive circuit of an electrooptic device according to Claim 1-~~or~~3.

16. (Amended) An electrooptic device havingcomprising:
pixels which include pixel electrodes disposed in correspondence with intersections between a plurality of scanning lines and a plurality of data lines, switching elements for controlling voltages to be applied to the respective pixel electrodes, an electrooptic material encloseddisposed in intersection areas between the plurality of data lines and the plurality of scanning lines, and a counter electrode arranged in opposition to the pixel electrodes, and

a drive means for supplyingdevice that supplies an ON voltage of, at least, a saturation voltage capable of saturating a transmission factor of the electrooptic material or an OFF voltage capable of bringing the electrooptic material into a non-transmissive state, thereby to implement a subfield drive in which a gradation is displayed in accordance with states of a light transmissive state and the non-transmissive state of the electrooptic material in a unit time, and a time ratio of the states, wherein that:

_____ the drive meansdevice:

_____ sets as control units a plurality of subfields into which a field period is divided on a time base,

_____ sets a time period of each of the subfields to be shorter than a saturation response time which is required for saturating the transmission factor of the electrooptic material in the case of applying the ON voltage, and

Docket No. 111830.01

_____ determines, on the basis of display data, the subfields for which to apply the ON voltage ~~therein~~ and the subfields for which to apply the OFF voltage ~~therein~~, thereby to express the gradation.

17. (Amended) An electronic equipment comprising an electrooptic device according to Claim 15-~~or~~ 16.

18. (Amended) A drive method of an electrooptic device that divides each field into a plurality of subfields on a time base, and drives a plurality of pixels which include an electrooptic material enclosed in intersection areas between a plurality of data lines and a plurality of scanning lines, by an ON voltage or an OFF voltage in each of the subfields in accordance with gradation data, whereby the respective pixels are brought into transmissive states or non-transmissive states so as to display gradations within one field by a subfield drive scheme; characterized by: the method comprising:

performing control so that pulse signals for bringing the respective pixels into the transmissive states may be concentrated in ~~the~~a first half of ~~the~~a pertinent field.

19. (Amended) A drive method of an electrooptic device according to Claim 18, wherein that, in a case where display content changes at changeover of fields in displaying a dynamic picture image, the pulse width of the pulse signals for bringing the pixels into the transmissive states in a later field is being altered in accordance with ~~the~~a direction in which ~~the~~a brightness of ~~the~~a screen changes.

20. (Amended) A drive method of an electrooptic device according to Claim 18, wherein that pulse signals for bringing the respective pixels into the non-transmissive states are being outputted in, at least, ~~the~~a last of the subfields of ~~the~~a pertinent field.

21. (Amended) A drive method of an electrooptic device according to Claim 18, wherein that the pulse width of the pulse signals for bringing the pixels into the transmissive

states is being altered in each field in accordance with the at least one of a temperature of the electrooptic material itself or the and an ambient temperature of the electrooptic material.

22. (Amended) A drive circuit of an electrooptic device having pixels which include:

pixel electrodes disposed in correspondence with intersections between a plurality of scanning lines and a plurality of data lines; ;

switching elements for controlling that control voltages to be applied to the respective pixel electrodes; ;

an electrooptic material enclsoed disposed in intersection areas between the plurality of data lines and the plurality of scanning lines; ;

a counter electrode arranged in opposition to the pixel electrodes;

wherein the drive circuit divides dividing each field into a plurality of subfields on a time base, and drives driving the pixels by an ON voltage or an OFF voltage in each of the subfields in accordance with gradation data, whereby the respective pixels are brought into transmissive states or non-transmissive states so as to display gradations within one field by a subfield drive scheme, the drive circuit comprising:

a control means for performing device that performs control so that pulse signals for bringing the respective pixels into the transmissive states may be concentrated in the a first half of the a pertinent field.

23. (Amended) A drive circuit of an electrooptic device according to Claim 22, wherein that, in a case where display content changes at changeover of fields in displaying a dynamic picture image, the control means alters the device altering a pulse width of the pulse signals for bringing the pixels into the transmissive states in a later field in accordance with the a direction in which the a brightness of the a screen changes.

24. (Amended) A drive circuit of an electrooptic device according to Claim 22, wherein that the control means outputs device outputting pulse signals for bringing the respective pixels into the non-transmissive states, in, at least, the a last of the subfields of the pertinent field.

25. (Amended) A drive circuit of an electrooptic device according to Claim 22, further comprising:

a temperature detection means for detecting the device that detects at least one of a temperature of the electrooptic material itself or the and an ambient temperature of the electrooptic material; and

a pulse width correction means for making device that makes corrections so that the a pulse width of the pulse signals for bringing the pixels into the transmissive states as is predetermined in correspondence with each gradation may be altered on the basis of a detection output of the temperature detection means device in each field.

26. (Amended) An electrooptic device, comprising:

pixels which include pixel electrodes disposed in correspondence with intersections between a plurality of scanning lines and a plurality of data lines, switching elements for controlling that control voltages to be applied to the respective pixel electrodes, an electrooptic material enclsoed disposed in intersection areas between the plurality of data lines and the plurality of scanning lines, and a counter electrode arranged in opposition to the pixel electrodes;

a scanning line drive circuit which that supplies scanning signals for dividing each field into a plurality of subfields on a time base, and for rendering that renders the switching elements conductive in each of the plurality of subfields, to the scanning lines;

a data line drive circuit which supplies binary signals for designating at least one of an ON voltage or and an OFF voltage of the pixels and thus bringing the pixels into

transmissive states or non-transmissive states on the basis of gradation data in each of the subfields, to the data lines corresponding to the pertinent pixels, the binary signals being supplied in time periods in which the scanning signals are respectively supplied to the scanning lines corresponding to ~~the~~^a pertinent pixels; and

a control means for controlling device that controls the data line drive circuit so that pulse signals for bringing the respective pixels into the transmissive states may be concentrated in ~~the~~ a first half of each field.

27. (Amended) An electrooptic device according to Claim 26, wherein that, in a case where display content changes at changeover of fields in displaying a dynamic picture image, the control means alters the device altering a pulse width of the pulse signals for bringing the pixels into the transmissive states in a later field in accordance with the direction in which the a brightness of the a screen changes.

28. (Amended) An electrooptic device according to Claim 26, wherein that the control means outputs device outputting pulse signals for bringing the respective pixels into the non-transmissive states, in, at least, the a last of the subfields of the pertinent field.

29. (Amended) An electrooptic device according to Claim 26, further comprising:

a temperature detection means for detecting the device that detects at least one of a temperature of the electrooptic material itself or the and an ambient temperature of the electrooptic material; and

a pulse width correction means for making device that makes corrections so that ~~the~~a pulse width of the pulse signals for bringing the pixels into the transmissive states as is predetermined in correspondence with each gradation may be altered on the basis of a detection output of the temperature detection ~~means~~ device in each field.

30. (Amended) An electronic equipment comprising an electrooptic device according to any of ~~Claims 26 through 29~~ Claim 26.

31. (Amended) A drive method of an electrooptic device that divides each field into a plurality of subfields on a time base, and controls and drives the subfields for bringing into a transmissive state each of a plurality of pixels which include an electrooptic material ~~enclased~~ disposed in intersection areas between a plurality of data lines and a plurality of scanning lines, by an ON voltage or an OFF voltage in accordance with display data, whereby the respective pixels display gradations within one field by a subfield drive scheme, ~~characterized by~~, the drive method comprising:

bringing at least one of the subfields in which ~~the~~ a pertinent pixel is to be brought into the transmissive state and which are successively arranged in the first half of the pertinent field on the basis of the display data, into a non-transmitting condition in conformity with rules stipulated by ~~the~~ display data.

32. (Amended) A drive method of an electrooptic device according to Claim 31, ~~wherein that~~, among the subfields in which the pertinent pixel is to be brought into the transmissive state and which are successively arranged in ~~the~~ a first half of the pertinent field on the basis of the display data, at least one subfield other than the subfield where the transmissive state starts, but which lies in the vicinity thereof ~~is~~ being brought into the non-transmitting condition in conformity with the rules stipulated by the display data.

33. (Amended) A drive method of an electrooptic device according to Claim 31, ~~wherein that~~, among the subfields in which the pertinent pixel is to be brought into the transmissive state and which are successively arranged in the first half of the pertinent field on the basis of the display data, at least one subfield other than the subfield where the transmissive state ends but which lies in the vicinity thereof ~~is~~ being brought into the non-transmitting condition in conformity with the rules stipulated by the display data.

P A T T E R N S O C I E T Y

34. (Amended) A drive circuit of an electrooptic device having pixels which include:

_____ that include pixel electrodes disposed in correspondence with intersections between a plurality of scanning lines and a plurality of data lines,

_____ switching elements ~~for controlling~~ that control voltages to be applied to the respective pixel electrodes,

_____ an electrooptic material enclosed in intersection areas between the plurality of data lines and the plurality of scanning lines, and

_____ a counter electrode arranged in opposition to the pixel electrodes;

wherein the drive circuit ~~controls~~ controlling the subfields for bringing each of the pixels into a transmissive state, by an ON voltage or an OFF voltage, whereby the respective pixels display gradations within one field by a subfield drive scheme;

the drive circuit comprising:

~~a control means for performing~~ device that performs control so that at least one of the subfields in which ~~the~~ a pertinent pixel is to be brought into the transmissive state and which are successively arranged may be brought into a non-transmitting condition.

35. (Amended) An electrooptic device, comprising:

pixels which include pixel electrodes disposed in correspondence with intersections between a plurality of scanning lines and a plurality of data lines, switching elements for controlling voltages to be applied to the respective pixel electrodes, an electrooptic material ~~enclosed~~ disposed in intersection areas between the plurality of data lines and the plurality of scanning lines, and a counter electrode arranged in opposition to the pixel electrodes;

PCT/US2003/020007

a scanning line drive circuit which supplies scanning signals for dividing each field into a plurality of subfields on a time base, and ~~for rendering~~ that renders the switching elements conductive in each of the plurality of subfields, to the scanning lines; and

a control means for controlling ~~device that controls~~ a data line drive circuit so that pulse signals for bringing the respective pixels into transmissive states may be concentrated in ~~the~~a first half of the field, and that at least one of the pulse signals which bring the pixels into the transmissive states and which are successively arranged may be brought into a non-transmitting condition in accordance with display data.

36. (Amended) An electronic equipment comprising ~~an~~the electrooptic device according to Claim 35.